# Master Internship Proposal

**Fracture of porous ceramics: application to the mechanical reliability of Solid Oxide Cells during thermal cycling**

## 1. Context

Solid Oxide Fuel Cells (SOFC) and Solid Oxide Electrolysis Cells (SOEC) are promising electrochemical converters operating at high temperatures. Among several advantages, SOFCs and SOECs can reach a very high efficiency without the use of specific electro-catalyst. Thanks to their reversibility, the same device can be alternatively used in fuel cell and steam electrolysis modes. The SOFC/SOEC are made of ceramic materials and they consist in two porous electrodes separated by a dense electrolyte. In planar configuration, the cells are assembled with metallic interconnects to form a stack of high power density. Because of the mismatch in Thermal Expansion Coefficients (TEC) between all the stack components, the cell layers are subjected to significant internal stresses. During the accumulation of start and shutdown of the system, the thermomechanical loading can induce damage in the electrode which leads to decrease the global system efficiency. Nowadays, the SOFC/SOEC mechanical degradation remains an issue for the application that still needs to be precisely investigated. In this frame, it is necessary to study the brittle fracture behavior of the porous SOFC/SOEC ceramics.

## 2. Work plan

The Master thesis aims to evaluate the mechanical degradation of the SOFC/SOEC electrodes. In this objective, the fracture properties of the studied porous ceramics will be measured by using an available instrumented micro-indentation setup. For the experiments, specific micropillars will be prepared in the ceramic membrane with a Plasma Focused Ion Beam (PFIB). The uni-axial compression test will be conducted beyond the damage initiation in the material. The results will be analyzed through a finite element modelling of the micro-indentation test.

**Dates:** From March 2018 to July 2018 (5 months)
**Host laboratory and collaborations:** CEA-Grenoble/LITEN/DTBH/LPH. The mechanical tests will be performed at INSA-Lyon/MATEIS (Lyon) and the modelling analyses will be done in collaboration with EPFL/SCI-STI-JVH (Lausanne).
**Applicant's profile:** a specialization in mechanics and/or physics of materials will be appreciated. **The internship could be followed by a Master thesis.**
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